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FIELD CROPS IN NEW YORK

Samuel R. Aldrich

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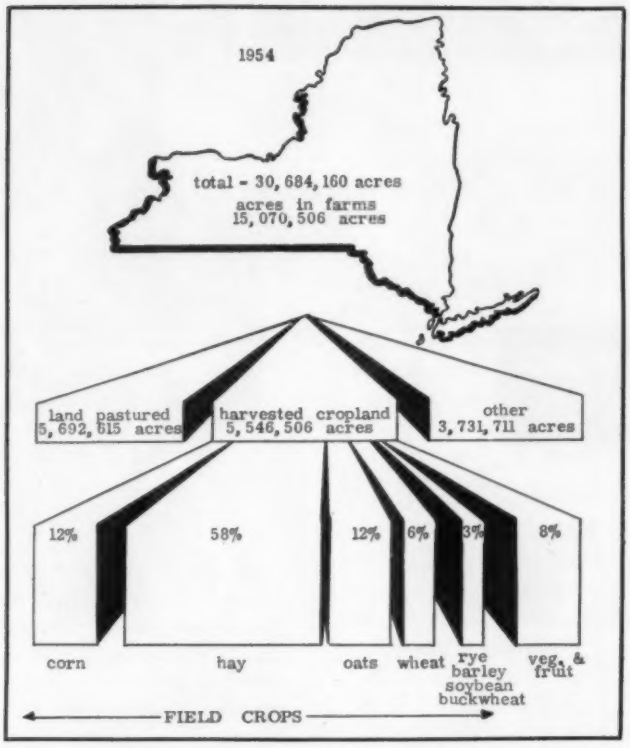
Some significant features of field crop production in New York are:

1. Field crops make a major contribution to the agricultural production of New York. Their value is often overlooked because they are not sold directly but are largely marketed through livestock.
2. Total harvested acres are declining, but the total production of roughages and grains is being maintained or increased.
3. Acre yields were nearly stable from 1870 to 1930, but since then have climbed steadily. The rate of yield increase is accelerating.
4. Tremendous improvements are being made in the efficiency of production in most crops but far more in some, such as grain corn, than in others, such as hay. Thus, the competitive position of certain crops is being improved relative to others.



FIELD CROPS IN NEW YORK AGRICULTURE

Samuel R. Aldrich

Field crops make the largest single contribution to New York agriculture. They account for 93 percent of the harvested cropland. In the 1954 census field crops harvested were valued at $221,110,000 and pasture would add at least $10,000,000. All other crops sold (fruit, vegetables, potatoes, beans, flowers, specialty crops, and miscellaneous) total about $172,400,000. The gross sales of livestock products are large, but when adjusted for the value of home-grown crops and purchased grain that are fed, livestock contribute much less to the agriculture of the state than crops. Field crops and livestock could, of course, not actually be separated in the state because livestock provide the market for 80 percent of the field crops that are produced. Livestock consume most of the field crops and convert them into milk, meat, and eggs.

This bulletin describes in a general way the climatic and soil conditions under which crops are grown in the state, presents data on changes in acres, yields, and amounts produced since 1870, shows changes in the efficiency and relative costs to grow the various field crops, and finally gives a brief description of individual crops and how they are grown. Specific recommendations on corn hybrids, crop varieties, fertilizers, and chemical weed killers are not presented. They can best be obtained by consulting the annual recommendations of the New York State College of Agriculture. These recommendations are available each year from all representatives of the Extension Service, from other governmental agencies, from local seed and fertilizer dealers, and from vocational agriculture teachers.

Figure 1. Generalized type of farming areas of New York. Adapted from A. E. Mimeo. 952, 1954

TYPE-OF-FARMING REGIONS

New York has a highly diversified agriculture. Field crops are important in all farming areas except Long Island and local areas scattered upstate where fruit, vegetables, or potatoes are grown intensively. The fruit areas are limited first by climate and to a lesser extent by soils. The areas of intensive vegetable production are determined by soils, climate, and in some places, nearness to a fresh market. Specialized grain farms are limited to areas with favorable topography, soils, and climate.

Dairying is important nearly everywhere in the state except Long Island and small areas upstate with intensive specialized farming, and it is nearly the entire system of farming in much of the state that is not well suited to fruits, vegetables, potatoes, or cash grains, mainly wheat and corn. Poultry is the second ranking livestock in the state. It is scattered throughout the state with special concentrations in five regions not influenced much by soils, climate or topography.

FARMS: NUMBER, SIZE, LAND IN FARMS

The number of farms and land in farms are changing rapidly (table 1). The changes that relate specifically to field crops are presented in detail on pages 8 and 9.

Table 1. Changes in number of farms and land in farms, New York 1850-1954

Year	Farms		Land in farms		Acres per Farm
	Number	Index (1900 = 100)	Acres	Index (1900 = 100)	
1850	170,621	75	19,119,084	84	112
1860	196,990	87	20,974,958	93	106
1870	216,253	95	22,190,810	98	103
1880	241,058	106	22,900,000	101	95
1890	226,223	100	21,961,562	97	97
1900	226,720	100	22,648,109	100	100
1910	215,597	95	22,030,367	97	102
1920	193,195	85	20,632,803	91	107
1930	159,806	70	17,979,633	79	113
1940	153,237	68	17,170,337	76	112
1945	149,490	66	17,568,471	77	118
1950	124,977	55	16,016,721	71	128
1954	105,714	47	15,070,832	67	143

Source. U. S. Census of Agriculture

Figure 2. Relief map of New York State. Elevation often makes a difference in the length of growing season

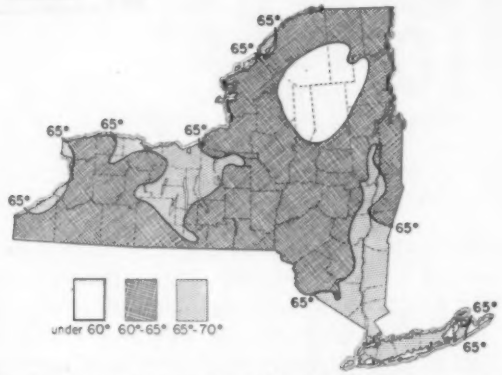


Figure 3. Mean temperature for the growing season, May 1 to September 30

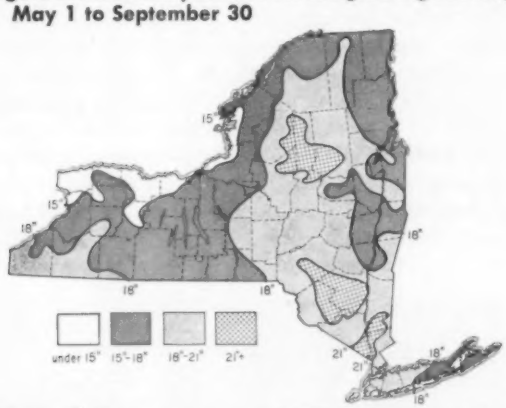


Figure 4. Mean average rainfall for the growing season. The rainfall pattern is not always associated with average summer temperature or elevation

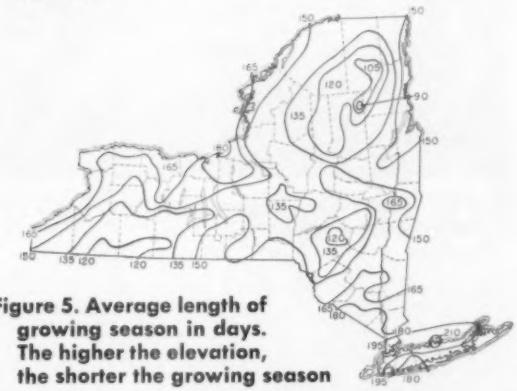


Figure 5. Average length of growing season in days. The higher the elevation, the shorter the growing season

THE GROWING SEASON

The factors of climate that strongly influence field crop production are the length, temperature, and rainfall of the growing season. Temperature is affected by elevation and latitude.

ELEVATION. Field crops are grown from near sea level on Long Island and along the Hudson River below Albany to about 2,300 feet in a few places in the southern tier (figure 2). Within a region, high elevation generally means a shorter, cooler growing season. A difference of 1,000 feet often makes a difference of two weeks or more in *effective growing season* for farms that are only a few miles apart.

SUMMER TEMPERATURE. Temperature (figure 3) influences the rate of growth of crops. There are important differences among crops. For example, corn grows best near the maximum temperatures in New York if moisture is adequate. Oats and grass meadows are favored by moderate temperatures. The mean July temperature ranges from a low of 64° in the Adirondacks to 74° in places in the Hudson Valley. Locally the maximum temperatures average several degrees higher in the valleys than on nearby hilltops 800 to 1,000 feet above the valley.

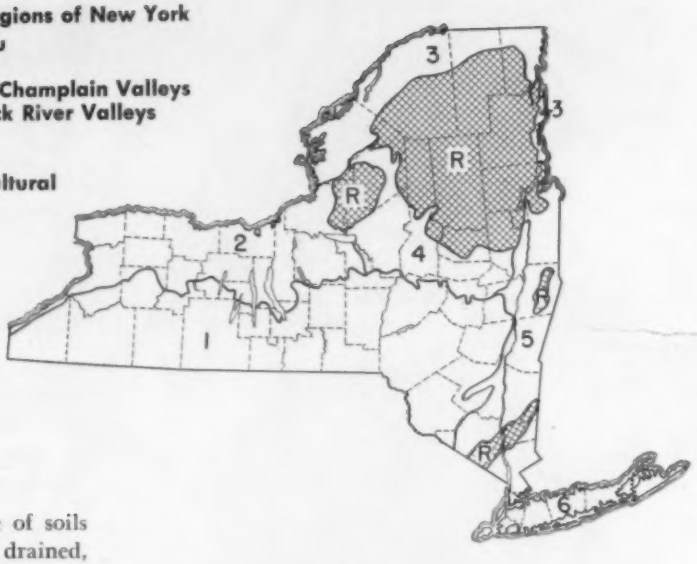
RAINFALL. The average rainfall during the growing season in farmed areas ranges from less than 15 inches along Lake Ontario to more than 21 inches in three areas in the eastern half of the state. Low summer rainfall increases the likelihood of drouth. High summer rainfall favors high yields but often means difficulty in timely operations, especially hay harvest (figure 4).

LENGTH OF GROWING SEASON. The frost-free period (figure 5) ranges from 90 days in the Adirondacks to about 210 days on Long Island. The practical lower limit for farming is approximately 120 days. In regions with short growing seasons, the valley farms are often favored by warmer summer temperatures and sometimes also by well-drained soils that permit earlier planting than on the hills.

In practical terms, the effective growing season on a field is influenced by (a) soil drainage, which determines how early the field can be fitted and planted, (b) summer temperatures, which influence rate of growth, and (c) the length of the frost-free period.

Figure 6. Major land regions of New York

1. **Allegheny Plateau**
2. **Ontario Plain**
3. **St. Lawrence and Champlain Valleys**
4. **Mohawk and Black River Valleys**
5. **Hudson Valley**
6. **Long Island**
7. **Rough, non-agricultural**



LAND REGIONS

GENERAL. New York has a wide range of soils from sands to clays, drouthy to very poorly drained, stony to nonstony, strongly acid to neutral, and high to low in organic matter and potassium supplying power. Widely different soils occur on neighboring farms and sometimes within a field. Specific information on individual soils can best be obtained by studying a detailed soil map and by having the soil tested for acidity, phosphorus, potassium, and organic matter.

The map (figure 6) shows the regions of the state in terms of land forms. Certain general statements can be made about the soils and problems of the regions.

1. ALLEGHENY PLATEAU. This is the hill-valley region (figure 7) called the "Southern Tier". Most of the farmland is between 1,000 and 2,000 feet elevation with some up to 2,300 feet. Hilliness increases from west to east. Perhaps one-fifth in the west and one-half in the eastern part is hilly and steeper than 15 percent slope. Average soil drainage improves from west to east. The drainage of nearly one-half the soils in the western part but only one-fourth of those in the eastern part is classed as somewhat poor or wetter. Most soils were originally moderately to strongly acid and medium in texture. The soils in the valleys are mainly gravelly loams and respond very well to lime, fertility practices, and good management. Where soil drainage is moderate to good, the uplands also respond well. Most soils have a fair to good supply of organic matter and are medium in potassium supplying power. Stoniness is a common problem. This is primarily a dairy region with potatoes and vegetables as important crops in a few places.

2. ONTARIO PLAIN. This is the most important farming region in the state. It is a lowland plain (figure 8), mostly undulating to level, with an elevation mostly between 500 and 1,000 feet. This is the large area of New York soils derived from limestone. The soils, however, grade into the acid soils on the south and are generally acid in the area bordering the southeastern part of Lake Ontario. Topography presents a problem on some farms in the eastern half where there are drumlins and hills. There are more soils in this region with a combination of favorable elevation, topography, moisture-holding capacity, pH, drainage, and potassium supplying power than in any other large region in the state. There are scattered large and small areas of

Figure 7. Hill-Valley Region "Southern Tier". Primarily a dairy region

heavy clay soils that are slow to drain and difficult to work. Even the better farms have some fields where drainage is a problem. The somewhat poorly drained and wetter soils range from 35 percent in Niagara County to 17 percent in Monroe, and 20 percent in Onondaga. Hilly areas make up only 2 percent of Niagara and 8 percent of Monroe, but 15 percent of Onondaga County. There are several important areas of organic soils intensively farmed in this region.

3. ST. LAWRENCE AND CHAMPLAIN VALLEYS. This is commonly called the "north country". The farmed areas are mostly 200 to 600 feet in elevation, but because they are so far north in the state, they have a rather short effective growing season. The lowlands are flat to undulating (figure 9) and in some large areas rock outcrop is common. Many of the soils are lake-laid clays with a problem both of surface and internal drainage. The surface soils are moderately acid even though there was limestone in the material from which they formed. There are smaller areas of soils from glacial till, some strongly acid and others near neutral. In Franklin and Jefferson Counties about 40 percent of the soils are classed somewhat poor or wetter in drainage. Only 2 percent of the farmland is hilly and steep. Bordering the Adirondack Mountains the elevation increases, there are many stony and drouthy soils, and some large sand plains. The agriculture of the "north country" is mainly dairying.

4. MOHAWK AND BLACK RIVER VALLEYS. These valleys in east central New York slope to highlands on each side. Starting on the Adirondack side, these valleys are bordered first by a band of stony or sandy acid soils, second by a belt of high-lime soils from limestone or shale and with good physical conditions, third a zone of acid shaley soils with restricted drainage, and finally on the south by rolling to hilly, high-lime soils at high elevations. Locally there are areas of clays and sands. The region is moderately favorable for cropping, with some very good areas. In the region as a whole, perhaps 20 to 40 percent of the farmland is classed as somewhat poor or wetter in drainage. About 8 to 20 percent has slopes of 15 percent or greater. This is mainly a dairy region, with vegetables important on some farms and on the improved organic soils (figure 2).

5. HUDSON VALLEY. This is a highly diverse region with most farmland between 100 to 1,000 feet in elevation. The farmed area is mainly undulating to rolling. The region is bordered by the Catskill and Adirondack Mountains on the west and by steep rocky topography on the east. Soils are mainly acid and of medium texture, but there are sizeable areas of clay in Washington County and bordering the Hudson river. In the region as a whole, there are many shallow and stony soils, but many soils respond well to treatment. Poor drainage is only a moderate problem for the region but is important locally. Nearly one-half of Dutchess County is nonagricultural because it is too steep, stony, or shallow. Nonagricultural land may be 70 percent in Rockland, 30 percent in Orange, and slightly more than 30 percent in Washington County. Dairy, fruit, and in some areas, vegetables are important.

Figure 8. Ontario Plain with soils derived from limestone. This is alfalfa on clay

6. LONG ISLAND. The island is an area with low relief and mainly sandy soils with few stones, naturally strongly acid and low in fertility. The sandy soils are low in water-holding capacity, but there are local areas of loams and fine sandy loams that are less drouthy. Because of the nearness to a market in New York City and the ease of working the soils, an intensive agriculture has developed with vegetables and potatoes which are heavily fertilized and mostly irrigated.

Figure 9. St. Lawrence and Champlain Valley topography. Many soils are from lake-laid clay, as visible in the background

TRENDS IN ACRES

Harvested cropland (table 2) has declined from a high of 8,900,00 acres in 1890 to 1899 to 5,600,000 by 1956. The main loss has been in hay from nearly 5 million to about 3 million acres, but the percentage of harvested cropland in hay has remained nearly constant. The acres lost, especially in hay, oats, and buckwheat, were some of the poorest land and to a considerable extent represent farm abandonment.

Figure 10 shows that oat acreage has declined nearly 50 percent. All corn has remained constant but an increasing proportion is harvested for grain. Wheat acreage declined sharply to about 1930. Since then the acreage has been alternately reduced by government controls and expanded by high price supports. Spring barley, rye, and buckwheat which were once important grain crops have declined to a minor place.

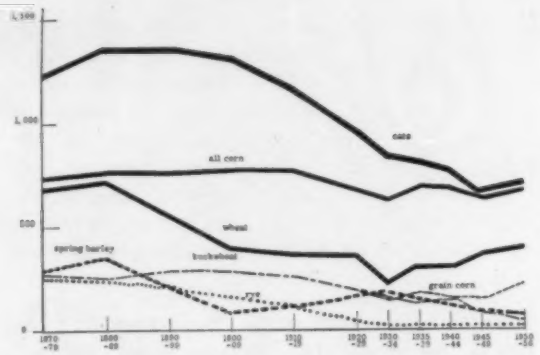


Figure 10. Acres of selected field crops in New York, 1870–1956. N. Y. State Dept. of Agr. and Markets. Acreage of wheat was influenced by Government programs since 1933

Total acres of harvested cropland has declined sharply since 1930 and the decline has not yet been arrested. The trend continues toward more intensive use of the better land and non-farm use of the poorer land.

Table 2. Acres of selected field crops in New York, and proportion of harvested cropland in each crop, 1870-1956. N. Y. State Dept. of Agr. and Markets[1]

Period	Harvested cropland	All hay		Corn[2]					Wheat		Oats[3]		Barley[3]		Rye		Buck-wheat	
				All corn		Silage	Forage	Grain										
	Acres	Acres	%	Acres	%	Acres	Acres	Acres	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
1870–79	8,700	4,200	48.3	725	8.3				687	8.0	1,237	14.2	293	3.3	254	2.9	276	3.2
1880–89	8,700	4,804	55.2	754	8.7				714	8.2	1,366	15.7	350	4.0	239	2.7	253	3.0
1890–99	8,900	4,944	55.5	759	8.5				555	6.2	1,361	15.3	203	2.3	208	2.3	286	3.2
1900–09	8,700	4,777	55.0	768	8.8				394	4.5	1,319	15.2	93	1.1	159	1.8	290	3.3
1910–19	8,300	4,759	57.3	754	9.1				363	4.4	1,166	14.0	115	1.3	115	1.4	262	3.2
1920–29	8,200	4,722	57.6	664	8.1	342	129	192	348	4.2	962	11.7	163	2.0	40	0.5	196	2.4
1930–34	7,100	4,042	57.0	622	8.7	377	102	143	217	3.1	851	12.0	167	2.4	21	0.3	156	2.2
1935–39	7,000	3,990	57.0	684	9.7	439	72	173	292	4.2	815	11.6	146	2.1	22	0.3	138	2.0
1940–44	6,750	3,951	58.5	675	10.0	451	76	149	290	4.3	768	11.4	116	1.7	17	0.2	140	2.1
1945		4,021		657		460	67	130	343		663		102		10		98	
1946		3,968		664		465	46	153	206		802		114		8		113	
1947		3,752		598		436	27	135	371		473		93		15		114	
1948		3,642		634		445	25	164	434		672		90		17		91	
1949		3,397		647		452	25	170	391		719		79		17		76	
1945–49	6,350	3,756	59.1	640	10.1	452	38	150	349	5.5	666	10.5	96	1.5	13	0.2	90	1.6
1950		3,365		666		456	25	185	399		719		81		17		75	
1951		3,297		639		447	20	172	407		755		74		12		55	
1952		3,250		645		414	16	215	440		770		70		9		48	
1953		3,289		664		422	20	222	471		670		64		11		55	
1954		3,220		704		464	21	219	353		717		80		15		50	
1950–54	5,650	3,284	58.1	664	11.7	441	20	206	414	7.3	726	12.8	74		13		57	0.23
1955		3,066		718		466	19	233	316		701		67		12		27	
1956		3,130		696		443	22	231	310		561		64		15		30	
1955–56		3,100																

[1]Data from 1870–1920 from Bul. 264, 1932; from 1920–1953 R.M.A. Release No. 16, 1955; since 1953 from annual summaries
[2]Distribution of corn acreage among silage, forage, and grain is not available before 1920. Silage became important between 1880 and 1910.
[3]The acreage of oats-barley mixtures is allocated between the two crops. The acreage of mixtures has been small since about 1950. Since 1950 an increasing acreage of winter barley has been reported in the total barley acreage. In 1955 and 1956 winter barley approached 50 per cent of the total.

YIELD OF FIELD CROPS

The acre yields of field crops (table 3 and figure 11) changed little over the 60-year period from 1870 to 1930. Improvements in varieties and cultural practices were offset by a decline in soil fertility. The farm use of modern research findings has had a major impact since 1930. Yield increases since then, based on the most recent 5-year period, have been: wheat 63 percent, hay 47 percent, corn 33 percent, and oats 32 percent. These increases have tremendous significance for both farmers and food consumers. A considerable part of the increase in hay yields is due to the fact that much of the 2,000,000 acres of hayland lost since 1900 was the poorer land. This same factor has likely caused some increase in oat yields, but it is not the cause of increases in corn and wheat yields, because the acres of these have not declined.

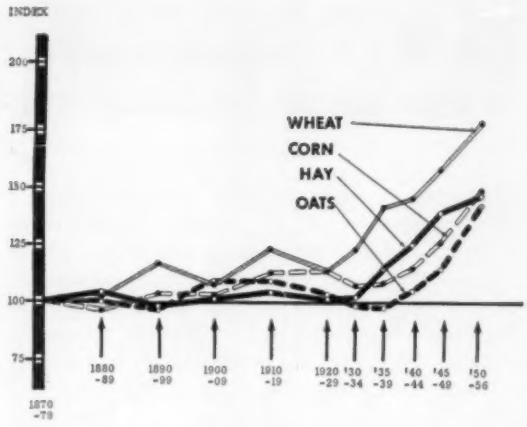


Figure 11. Index of yields of selected field crops, 1870–1956

1870-79 = 100, N. Y. St. Dept. of Agr. and Markets

Table 3. Acre yields of selected field crops in New York, 1870-1956 (N. Y. S. Dept. of Agr. and Markets)[1]

Period	All hay	Corn silage	Corn for grain[2]	Wheat	Oats	Barley	Buckwheat	Rye	Soybeans
	tons	tons	bu.	bu.	bu.	bu.	bu.	bu.	bu.
1870–79	1.14		31.8	16.5	29.0	21.6	14.4	11.6	
1880–89	1.18		27.4	16.8	29.1	23.1	12.8	12.6	
1890–99	1.12		33.0	19.2	28.2	22.8	16.6	13.6	
1900–09	1.15		32.7	17.6	31.2	22.1	19.9	14.6	
1910–19	1.19		35.6	20.2	31.2	26.8	16.1	15.4	
1920–29	1.15		35.8	18.6	30.0	26.2	17.6	14.2	
1930–34	1.16	9.36	33.9	20.1	28.8	24.8	17.8	15.3	
1935–39	1.30	9.28	34.5	23.2	28.3	24.3	16.4	17.2	14.4
1940–44	1.43	9.14	36.3	23.8	30.5	25.0	18.1	16.9	14.7
1945	1.61	8.4	35.0	26.4	29.0	25.0	15.5	17.5	14.0
1946	1.62	9.3	40.0	26.3	40.0	32.0	19.0	18.0	16.0
1947	1.61	8.4	35.0	24.0	27.5	24.0	13.5	18.5	15.0
1948	1.65	10.0	44.0	27.0	40.0	32.0	19.5	18.5	16.0
1949	1.36	10.0	46.0	26.9	29.0	25.0	21.0	18.4	18.0*
1945–49	1.57	9.22	40.0	26.1	33.1	27.6	17.7	18.1	15.8
1950	1.60	10.0	45.0	27.9	43.0	34.0	19.5	19.5	18.0*
1951	1.72*	9.9	46.0	25.0	48.0*	34.0	16.5	18.5	18.0*
1952	1.66	10.5*	49.0	29.0	37.0	31.0	22.5*	19.5	17.5
1953	1.69	10.0	48.0	29.5	39.0	30.0	20.0	19.5	16.0
1954	1.71	9.2	44.0	30.5	37.5	32.0	18.0	20.0	11.0
1950–54	1.68	9.92	46.4	28.4	40.9	32.2	19.3	19.4	16.1
1955	1.69	9.6	45.0	32.5*	41.0	36.0	21.0	21.0*	16.0
1956	1.71	9.8	53.0*	31.0	44.0	37.0	19.0	20.5	14.0

[1]Data from 1870–1920 from Bul. 264, 1932; from 1920–1953 from R.M.A. Release No. 16, 1955; since 1953 from annual summaries.
[2]Reported as grain equivalent for all corn, 1870 to 1923. Yield of corn actually harvested for grain since 1924.
*Highest state average yield recorded. The estimate for corn for grain in 1956 may be slightly high because corn was unusually wet.

AMOUNTS OF FIELD CROPS PRODUCED

The tons or bushels of field crops produced in New York are given in table 4. Although the acreage of hay has declined from nearly 5,000,000 to about 3,000,000, the tons of hay produced remained nearly the same. The 5.5 million tons shown for 1950 to 1954 compares with 5.5 to 5.7 million tons between 1880 and 1930. The low point was reached during the drouth and depression years of 1930–1934, and the high point between 1945 and 1950. Since 1920 the average date of harvest has been advanced about 10 to 14 days, which reduced the yield in tons but improved the quality.

The total amount of roughage produced (hay plus silage) increased from 1920 to 1940 and has since remained nearly stable in terms of 5-year averages.

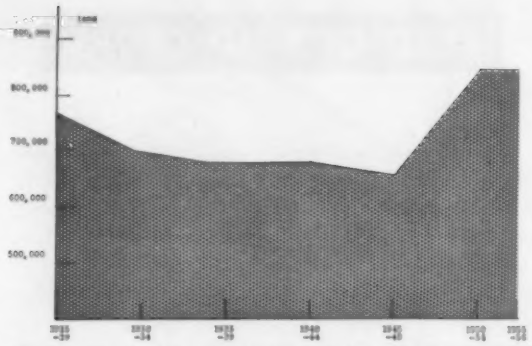


Figure 12. Total production of feed grain crops (corn, wheat, oats, barley, rye) in New York, 1925–1956. (A.E. Mimeo. 740, L. C. Cunningham Based on U.S.D.A. Crop Production Report.)

The amounts of 5 feed grains produced are shown in figure 12. The significant feature is the sharp increase since the 1945–1949 period. Some of the reasons for this increase are discussed on the following pages.

Table 4. Production of selected field crops in New York, 1870-1956, N. Y. S. Dept. of Agr. and Markets (Data from 1870-1920 from Bul. 264, 1932; from 1920-1953 from R.M.A. Release No. 16; since 1953 from annual summaries)

Period	All hay	Corn		Wheat	Oats	Barley	Buckwheat	Rye
		Silage[1]	Grain					
	Thousands of tons		Thousands of bushels					
1870–79	4,807		23,745[2]	11,365	35,831	6,348	3,977	2,965
1880–89	5,666		22,874	12,009	38,842	8,096	3,611	3,007
1890–99	5,566		25,051	11,074	38,620	4,493	4,732	2,834
1900–09	5,494		25,136	6,822	41,181	2,340	5,765	2,317
1910–19	5,678		26,833	7,345	36,507	2,987	4,196	1,790
1920–29	5,466	3,019[3]	4,877[3]	6,481	28,731	4,220	3,473	563
1930–34	4,692	3,537	4,856	4,533	24,598	4,136	2,747	327
1935–39	5,196	4,072	6,017	6,922	23,044	3,548	2,262	378
1940–44	5,644	4,113	5,479	7,077	24,255	2,912	2,488	295
1945	6,488	3,864	5,005	9,147	19,277	2,550	1,519	175
1946	6,416	4,324	6,123	5,648	32,360	3,648	2,147	144
1947	6,029	3,662	4,554	8,988	13,338	2,184	1,526	285
1948	6,016	4,450	7,938	11,886	28,320	2,752	1,767	342
1949	4,630	4,520	8,800	10,721	22,591	1,800	1,360	342
1945–49	5,916	4,164	6,484	9,278	23,167	2,587	1,664	258
1950	5,378	4,560	8,325	11,344	30,917	2,754	1,462	332
1951	5,678	4,425	7,912	10,319	36,240	2,516	908	222
1952	5,390	4,347	10,535	12,856	28,490	2,170	1,080	176
1953	5,564	4,220	10,656	13,894	26,130	1,920	1,100	214
1954	5,512	4,269	9,636	10,766	26,880	2,560	900	300
1950–54	5,504	4,364	9,413	11,836	29,731	2,384	1,090	245
1955	5,196	4,474	11,300	10,270	28,741	2,412	567	252
1956	5,367	4,341	12,243	9,610	24,684	2,368	570	308

[1]Silage does not include fodder corn which declined from 30 per cent of all corn in 1920–29 to 3 per cent in 1956.
[2]All corn reported as grain equivalent from 1870 to 1919.
[3]1924 to 1929 only.

CHANGES IN EFFICIENCY OF PRODUCTION

There are vast differences in the improvements that New York farmers have made in efficiency in growing field crops since 1914 (figure 13 and table 5). Farmers improved their methods little during the first 20 years. Since then a combination of higher yields through better varieties, more lime and fertilizer, better weed, insect, and disease control, and fewer hours per acre with modern machinery have made rapid improvements possible. These improvements trace directly to experiment station and industrial research.

Corn for grain shows by far the greatest improvement; thus it is in a relatively more favorable competitive position than in earlier periods. Wheat ranks second in improved efficiency. Oats and corn silage are third. Hay ranks far behind. There has been improvement in the quality of hay through earlier harvest and in corn silage by a higher grain content that is not reflected in figure 10 and table 5.

The gap in changing efficiency between hay and the other crops is widening. This partly explains why New York farmers are maintaining their acreages of corn and wheat but reducing hay. Also, as the yield per acre of hay has gone up farmers have been able to release acreage for the production of grain.

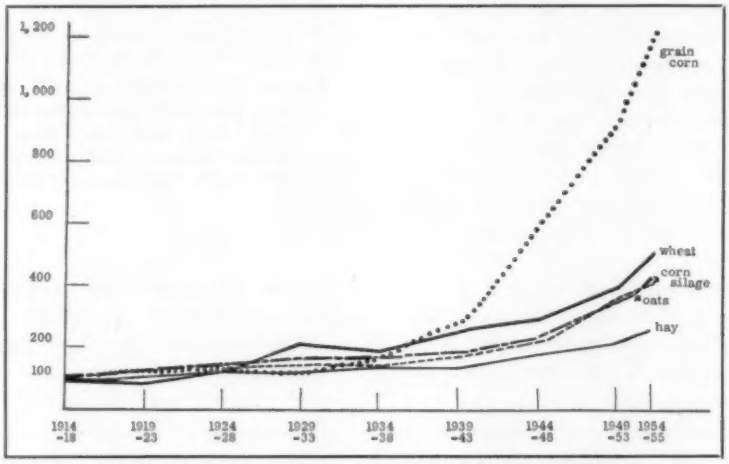


Figure 13. Index of changes in production of field crops per hour of labor 1914–1955. 1914–18 = 100. N. Y. Cost Account Farms

Table 5. Hours per acre and amount produced per hour of labor on selected field crops. N. Y. cost account farms, 1914-1955.

Period	Hay[1]		Corn silage		Grain corn		Wheat		Oats	
	Hours per acre	Tons per hour	Hours per acre	Tons per hour	Hours per acre	Bushels per hour	Hours per acre	Bushels per hour	Hours per acre	Bushels per hour
1914–18	10	0.15	37	.16	66	0.42	25	0.96	23	1.53
1919–23	11	0.14	39	.20	66	0.54	23	0.99	21	1.51
1924–28	9	0.18	36	.23	57	0.56	19	1.19	20	2.09
1929–33	9	0.19	33	.27	64	0.50	14	1.91	15	2.16
1934–38	8	0.20	34	.27	50	0.70	15	1.79	15	2.22
1939–43	8	0.21	29	.31	33	1.22	11	2.47	13	2.63
1944–48	8	0.26	23	.39	15	2.53	11	2.79	11	3.45
1949–53	6	0.32	18	.57	13	3.94	9	3.80	8	5.56
1954–55	6	0.37	13.5	.67	10	5.00	8	4.75	6.5	6.31

[1]Hay other than alfalfa from 1915 to 1948. Includes alfalfa 1949–1955.

COSTS TO GROW FEED CROPS

As has been mentioned, New York grows field crops mainly to feed to livestock. The costs to grow nutrients for feed in the different field crops are presented in table 6. These figures are for Cost Account Farms and represent above-average farmers in the state.

The first column under each crop reflects changes in the efficiency of production and changes in the general price level. The second column is adjusted for price changes by relating each cost to changes in farm prices in New York since 1914–1918. The data in the adjusted columns are presented in figure 14. Two points of significance are shown in the chart. First, the two roughage crops, hay and corn silage, no longer have the tremendous advantage they once had in costs of production over the other crops, especially wheat and grain corn. If the trends of the past twenty years continue for another ten years, the costs to grow a ton of digestible nutrients in grain corn, corn silage, and hay would be about equal. To a New York dairy or livestock farmer, a pound of digestible nutrients in grain is somewhat more valuable than a pound in hay.

The second point is that since the 1929–1933 period, the economics of growing feed crops grew steadily more favorable until the last period reported. Progessive farmers, typified by these Cost Account Farmers, were improving their efficiency of growing field crops during a period when prices were increasing.

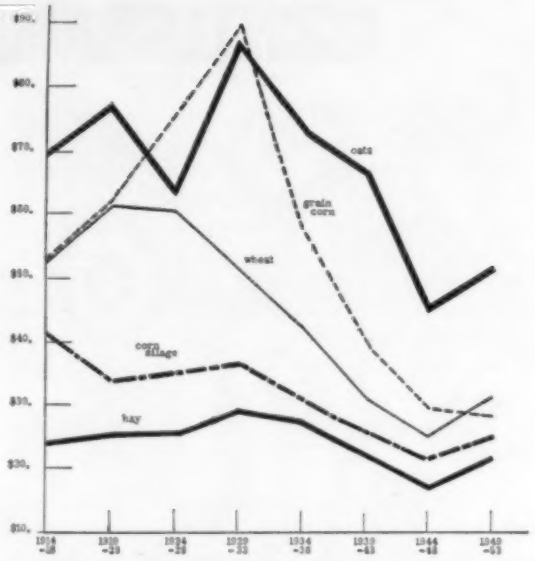


Figure 14. Changes in cost to grow one ton of total digestible nutrients in field crops, 1914–1953. Data are for actual costs adjusted for changes in New York farm prices since 1914–18. N. Y. Farm Cost Account Data

Table 6. Cost to produce one ton of digestible nutrients, 1914-1953, A. E. 984, forty years of farm cost accounts

Period	Hay[1]		Corn silage		Corn grain		Wheat		Oats		Barley	
	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]
1914–18	$24	$24.00	$41	$41.00	$53	$53.00	$53	$53.00	$69	$69.00	$69	$69.00
1919–23	32	25.20	43	33.86	79	62.20	78	61.42	97	76.38	85	66.93
1924–28	28	25.23	39	35.14	83	74.77	67	60.36	70	63.06	60	54.05
1929–33	24	28.57	31	36.90	75	89.29	43	51.19	72	85.71	54	64.29
1934–38	21	26.92	24	30.77	45	57.69	33	42.31	57	73.08	47	60.26
1939–43	22	22.00	26	26.00	40	40.00	31	31.00	56	66.00	59	59.00
1944–48	30	16.57	39	21.55	54	29.83	45	24.86	85	46.96	77	42.54
1949–53	39	21.20	46	25.00	52	28.26	56	30.43	94	51.09		

[1]Prior to 1949 the data were calculated from records on alfalfa and other hay reported separately.
[2]The cost figures in the "Adjusted" columns were obtained by dividing the actual costs by the index of New York farm prices using 1914–1918 as the base period. This adjustment was made in order to show real changes in costs as distinguished from changes due to the general price level. The index of Farm Prices from 1914–18 to 1949–53 was: 100, 127, 111, 84, 78, 100, 181, 184 for the 5-year periods in the table.

CASH GRAIN FARMING

Beginning in the 1940's there has been a trend toward specialized cash grain farms, mainly corn and wheat in the Ontario Plain region of central New York from Syracuse to Buffalo. The economic feasibility of growing grain corn in New York for

sale or feed in competition with the major cash grain area of the Corn Belt has been questioned.

Four factors favor the Corn Belt: higher acre yield, lower cost of fertilizer, more efficient use of labor and machinery, and lower drying cost. Yield on well adapted soils and with good agronomic practices will average perhaps 15 bushels to the acre higher in the corn belt. Figured at 1956–57 prices, this is about $20. Fertilizer cost is about $10 per acre less in the midwest, but the difference is rapidly decreasing. Labor and machinery can be used slightly more efficiently. Grain is less likely to be high in moisture at harvest.

Two factors favor New York, lower investment in land and higher price for the corn. Assuming a land value of $250 per acre in New York and $500 in Illinois, the difference in interest on the investment at 5 percent is $12.50 per acre each year. If the principal is paid off in 40 years there is an additional charge of $6.25 per acre each year for the Corn Belt. The two total $18.75. Market corn in New York does not enjoy the full margin of the cost of transportation from the Corn Belt, but the cash price advantage to New York farmers in 1956–57 was at least $10 per ton. Good production methods will produce 1¾ tons per acre, which means an advantage of $17.50 per acre.

The balance shows $30 per acre for the Corn Belt for yield and fertilizer plus increased efficiency in labor and machinery against $36.25 in New York for lower land charge and higher price for the corn. Some charge should likely be made for additional cost of drying high moisture corn in New York, although drying is not the usual practice.

This rough comparison indicates that *some farmers* in New York *with favorable soils, growing season,* and *sufficient acreage* to support modern machinery *can effectively compete* with Corn Belt farmers in growing corn for grain.

CORN

Corn ranks second in value ($51,444,332 in the 1954 census of Agriculture) among all crops harvested in New York. It is exceeded only by hay. It is the third ranking crop in acreage below hay and slightly below oats. The acreage of corn has changed little since 1870 (table 2 and figure 10). Prior to 1900 corn was grown mainly for grain and fodder. Silos became popular between 1880 and 1910. Fodder corn and much of that formerly husked was put into the silo (table 2). This trend has reversed since 1950.

Corn is best suited to areas with long, warm growing seasons. Corn for grain is concentrated in such areas (dot maps on page 17) on soils that are well enough drained to permit planting and cultivating on time; that are not too steep for modern machinery or so steep that erosion would soon ruin the soil. The development of good early hybrids has extended the areas where grain corn can be grown somewhat farther north and to higher elevations. The practical limit for grain corn is about 1,400 feet elevation in the central and southern counties and much lower in northern areas.

Corn silage is grown throughout the farming areas of the state. The practical limit for silage is about 2,100 feet elevation in central and southern parts of the state and much lower in the St. Lawrence and Champlain Valleys.

Corn usually follows the sod crop in the rotation because it capitalizes well on the organic matter and improved soil tilth left by the sod. Soil erosion is less when corn follows sod than when it follows a row crop. Typical rotations are corn, oats, hay (2 to 4 years) and in the Ontario Plain region, corn oats, wheat, hay (1 to 3 years).

The proportion of hybrid seed used has increased from 13 percent in 1940 to 91 percent in 1955.

Stalk rot is an important disease of grain corn. It causes mature plants to lodge and greatly increases field harvesting losses. The only control is through resistant hybrids.

SEEDBED. The typical seedbed for corn is prepared by plowing one to four weeks before planting. Fall plowing is common on heavy clay soils. After plowing, fields are usually harrowed 2 to 4 times with a disk or springtooth. Sometimes a cultipacker precedes the harrow. Since 1950 interest has developed in minimum tillage methods such as plow-plant and wheel-track planting. In minimum tillage methods the aim is to get a satisfactory seedbed

within the row but to leave the inter-row area somewhat loose and uncompacted (figure 15).

Figure 15. Soil is firmed in the row, but left loose between as in this plow-planted field

PLANTING. In representative years planting begins about May 10 in southeastern New York, in the valleys of the central part of the State, and on well-drained soils in the Ontario Plain; (see pages 6 and 7 for descriptions of the regions); about May 20 to 25 at higher elevations in the Allegheny Plateau; and May 25 to June 1 in the St. Lawrence and Champlain Valleys. The almost universal use of seed treated with a fungicide has since 1950 advanced the safe date to plant by a week to ten days. Corn is planted 1½ to 2 inches deep. Kernels are spaced 7 to 9 inches apart in fields which have 36-inch rows in order to provide 16,000 to 18,000 plants if 70 to 80 percent of the live seeds make plants. Row spacing varies from 30 to 44 inches and has little effect on yield if the kernel spacing is adjusted to give the desired number of plants (figure 16).

Figure 16. Modern corn planters precision place seed and fertilizer separately. The press wheels firm the soil over the row

FERTILIZING. Recommended fertilizer at planting time is a 1–1–1 ratio or a 1–2–2 ratio where extra nitrogen is supplied before plowing or as a sidedressing. Manure or a legume sod plowed under can substitute for perhaps one-half of the starter fertilizer and all or most of the supplemental nitrogen. A moderate row application is recommended to promote early growth. The ideal placement of fertilizer, as shown in figure 17, is slightly to the side and below the seed. Split-boot applicators are questionable when the amount of nitrogen plus potash (K^2O) exceeds 60 pounds.

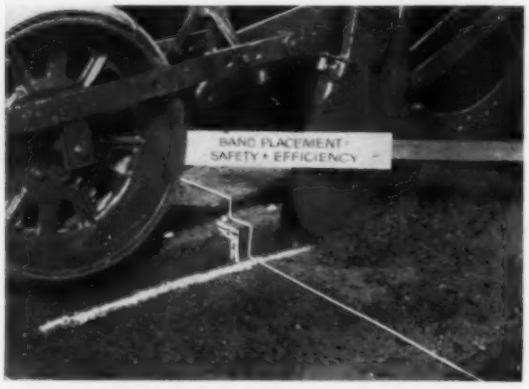


Figure 17. Close-up of fertilizer being placed to the side and below the corn seed

CONTROLLING WEEDS. Weeds rob farmers of many tons of silage and bushels of grain. Chemical spray early plus cultivation later make a good team (figure 18). Available chemicals change almost yearly and thus the latest recommendations should be checked. Many New York farmers who have a small corn acreage could improve the effectiveness of cultivation by better timing and more attention to the kind and placement of cultivator teeth.

HARVESTING. Until recently corn silage was all cut with a binder and then picked up from the ground. A rapidly growing proportion is cut and chopped in the field with a field chopper. The introduction of corn pickers from practically none in

Figure 18. Band spraying of herbicides at time of planting effectively controls weeds. Timely cultivation between the rows would have controlled the weeds shown here, purposely left to illustrate effectiveness of spraying

1940 to 4,766 in 1954 revolutionized the production of corn for grain. Beginning about 1955 picker-shellers which shell the grain corn in the field were used by a few farmers who had drying equipment (figure 19A and B).

Figure 19-A. The field chopper makes light work of a formerly back-breaking job

Figure 19-B. The self-propelled corn picker-sheller is the "new look" on some New York farms

STORING AND MARKETING. Most corn silage is stored in upright silos (figure 20A), with less than 5 percent in temporary and trench silos. Ear corn should be stored in cribs no more than 4½ feet in width (figure 20B), or in round cribs 4½ feet from the outside to an open center. In cribs with these dimensions ear corn may safely be cribbed at 30 to 35 percent moisture in the grain. Most corn is used on the farm where grown, although an increasing number of farmers in the Ontario Plain region are growing cash corn. Nearly all New York corn is fed to livestock.

Cornell Miscellaneous Bulletin 32 contains detailed information on field corn production in New York.

Figure 20-A. Filling an upright tile silo with field chopped corn

Figure 20-B. Narrow corn cribs provide adequate ventilation for safe storage and drying of grain corn

EIGHTY YEARS OF GRAIN CORN IN NEW YORK STATE. Map A on the facing page shows that in 1874 nearly all corn was grown for grain. Even then, the major acreage was concentrated in the Ontario Plain Region (figure 6), an area with gentle slopes, favorable climate and soils of high native fertility. A secondary concentration was located in the Hudson Valley Region, an area which also has a long growing season and where farmers had been established for a long period of time.

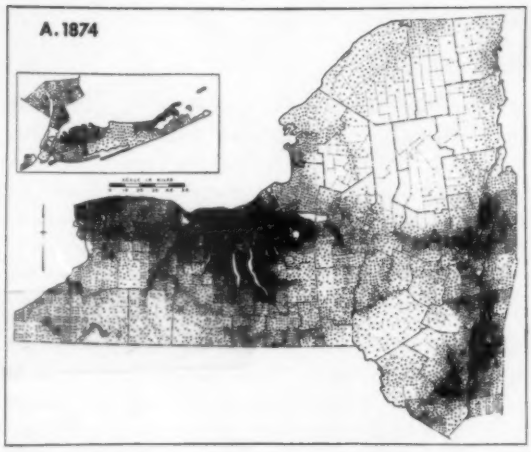
Map B shows a marked decrease in the acreage of grain corn by 1934. This was due to the shift to silage corn, resulting from the introduction of the upright silo. However, the total acreage for corn changed very little (table 2.)

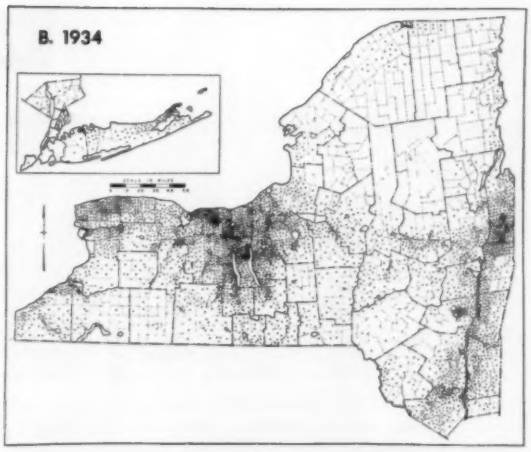
Map C shows a significant increase in grain corn in the Ontario Plain, a decrease in the Hudson Valley, with almost no grain corn being grown in the North Country by 1954. The factors contributing to the increased acreage of grain corn were: mechanization in areas with favorable climate and topography, farmer acceptance of hybrid corn with higher yielding potential, increased use of higher rates of complete fertilizer, especially those higher in nitrogen content, higher plant populations and better weed control practices.

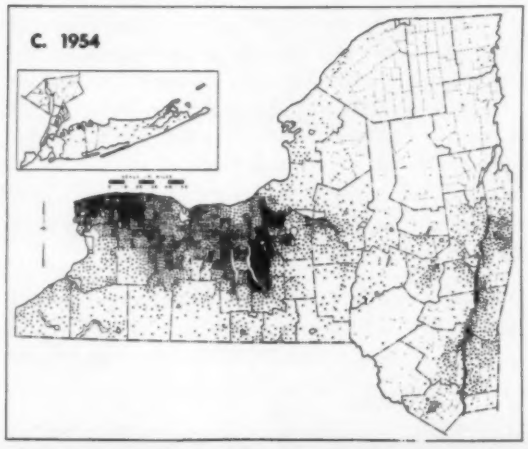
D. Farmers producing 100 bushels or more of shelled corn per acre are no longer exhibiting large ears of corn. The development of earlier maturing hybrids and research on plant population and fertility have shown conclusively that it is the number of well-matured, uniformly filled ears, averaging one-half pound each, that produce maximum yields. To obtain numbers of ears, there must be sufficient stalks per acre.

E. "You cannot judge a corn kernel just by its looks". The lower kernel in the picture shows the germ face; the upper one shows the opposite side. Such factors as plumpness, and degree of denting are indications of maturity but the percent moisture cannot be accurately judged. The selection of hybrids which will mature in the average growing season is desirable.

F. The corn plant is a vigorous feeder on plant nutrients and requires abundant moisture to produce maximum yields. Only if soil conditions are ideal and management practices optimum, can the corn grower expect to get maximum yields.







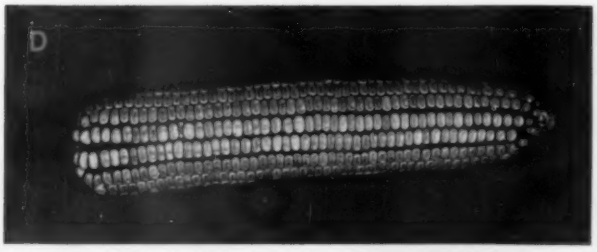


Figure 21. A,B,C. Corn acreage. 1 dot = 200 acres.
See discussion opposite page.

Seeds per pound 1200

Pounds per bushel: Ears 70
Shelled corn 56

WHEAT

Figure 22. Efficient production requires large scale machinery. A complete fertilizer is usually recommended

Wheat is the fourth ranking crop in acreage in New York and in the 1954 census it ranked third among field crops in value, $22,308,288. In 1954 the wheat crop was valued at two-thirds that of potatoes, all vegetables, or apples. The acreage of wheat declined sharply from 1890 to 1910 (table 2 and figure 10) and again in the early 1930's. Improved efficiency and government price supports promoted expansion during and following World War II. Acreage control programs cut wheat acreage to about 214,000 for harvest in 1957.

Wheat growing is concentrated in areas with moderate to well-drained soils, page 6, because winterkill is less than on poorer drained soils. Wheat is moderately sensitive to acid soils. For these reasons and because efficient production requires large scale machinery, wheat is concentrated in the Ontario Plain region. Research by the Cornell Agronomy Department proves that wheat can profitably be grown on wetter soils, at higher elevations, and likely farther north than has been thought possible. The key to satisfactory yields on these marginal situations is mainly earlier planting combined with proper liming and fertilizing.

A small acreage of spring wheat is grown, but yields are generally disappointing and the acreage is declining.

SEEDBED AND PLANTING. Plowing 2 to 4 weeks before planting is desirable. The seedbed needs to be moderately fine and firm to get uniform depth of coverage and to prevent drying of the seedbed around the roots of the young seedlings. The most serious insect pest of wheat has been the Hessian Fly, which is controlled through resistant varieties and avoiding the insect by planting after the "fly-free" date. Information on the fly-free date is available from the local county agricultural agent. Planting starts as early as September 1 in northern counties and at high elevations. Some farmers in the Lake Plain region plant into late October after beans are harvested, but this is risky and sometimes results in heavy winterkill. Wheat is drilled in rows 7 to 9 inches apart at a rate of about 2 bushels to the acre and 1 to 1½ inches deep (figure 22).

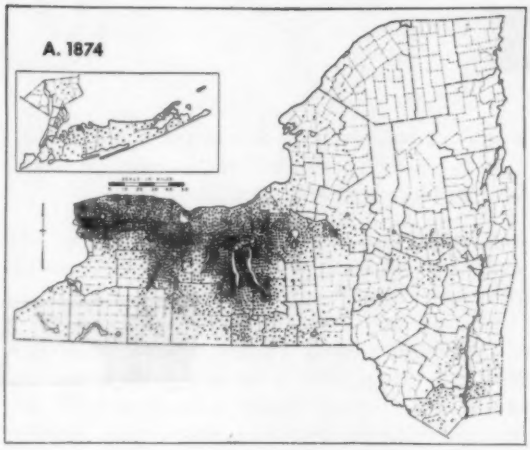
FERTILIZING. A complete fertilizer, usually a 1–2–1 or 1–2–2 ratio, is recommended for wheat at planting time. Twenty pounds of nitrogen is enough in the fall to promote good growth. Any additional is leached out over winter. Wheat responds well to phosphorus. The amount of potash to apply depends on kind of soil and the potassium shown by soil test. Spring topdressing with nitrogen between the time growth starts and plants are 8 to 10 inches tall is highly profitable on fields where wheat is not likely to lodge. Rates and kinds of materials may be obtained from annual recommendations from the College of Agriculture through its Extension Service.

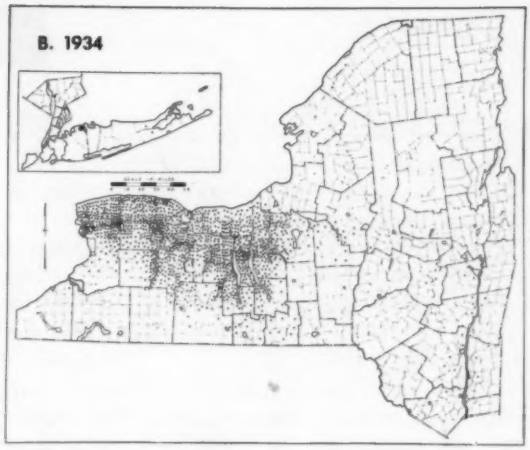
WEED CONTROL. Chemical sprays to control certain weeds may be applied in the fall. Others require spring application. The chemicals to use and recommended rates are revised each year.

HARVESTING. Nearly all wheat in New York is combined (figure 23). The moisture content for safe storage is 14 percent or less. This requires combining on bright days after the dew is off. If wheat is much above 14 percent moisture, it will mold and heat in storage.

STORING AND UTILIZING. Much of the wheat grown in the state is stored on the farm and fed to livestock. It is used extensively in poultry feed. About ⅔ is marketed. Of this, some is resold locally for livestock feed. The remainder is processed into flour suitable mainly for pastries, since New York wheat is of the soft type and not high in protein.

Figure 23. A self-propelled combine in operation. Nearly all wheat in New York is combined





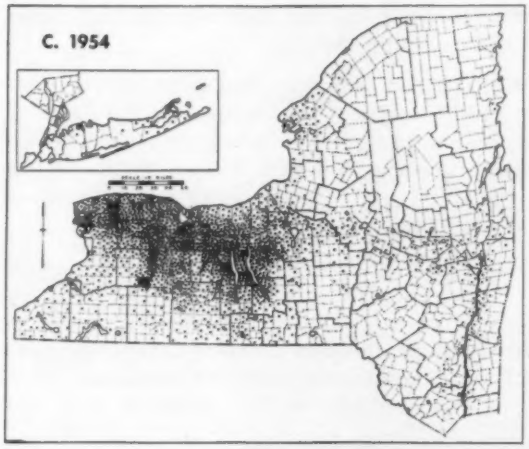


Figure 24. A,B,C. Wheat acreage. 1 dot = 200 acres
D. Wheat heads—long and well filled
E. Wheat seed—plump, uniform, and not discolored
F. Uniform stand of an improved wheat variety

Seeds per pound 16,000

Pounds per bushel 60

OATS

Oats rank second only to hay in acreage in New York. Among field crops it ranks fourth in value at $19,227,265 in the 1954 census. The acreage has declined almost 50 percent from the peak in the 1880's (table 2 and figure 10) but acre yields (table 3) have increased enough to offset much of the acreage decline (table 4). In 1930 about 1/3 of the oat acreage was grown in mixture with barley. By 1954 this had declined to 1/10.

Oats tolerate poorly drained soils better than wheat, corn, or barley. Highest yields are made when the crop heads and the grain develops in cool weather. High elevation and a northern latitude are no handicaps for oat growing as they are for corn or wheat. Warm summer temperatures and heavy rust attack reduce grain yields in southeastern counties, and most oats there are cut for silage or hay.

Three major problems with oats are (1) diseases, especially crown and stem rust, (2) late planting, and (3) lodging. Great improvement has been made through breeding disease-resistant and stiff-strawed varieties since 1945, but it is a never-ending job because new strains of rust evolve to attack the new varieties. The outlook is for new recommended varieties every few years.

Historically farmers planted seed from their previous year's crop. Since about 1945 there has been a rapid shift to buying new seed each year to assure the best variety, high purity, fewer weed seeds and diseases, and high germination.

Winter oats have been tried in New York but they usually winterkill. Research is in progress to develop more winter-hardy strains and may eventually lead to adapted varieties for the state.

SEEDBED AND PLANTING. About 75 percent of the oat acreage has a forage seeding made at the same time. To assure uniform shallow coverage of the forage, the seedbed is made more fine and firm than would be necessary for the oats. Fields are commonly fall plowed to facilitate early planting and to have a fine, firm seedbed for the forage seed. *Oats should be planted as soon in the spring as a seedbed can be prepared,* which may be as early as April 10 on well-drained soils in central New York to as late as June 10 on poorly drained soils in wet springs. Oats are drilled, as in figure 22, about 1½ inches deep in 7- to 9-inch rows. The planting rate is 1½ to 2 bushels to the acre as a companion crop; 2 to 2½ bushels when no forage seeding is made; and 2½ bushels for very late planting.

FERTILIZING. Fertilizer application, like the seedbed, is planned partly for the forage seeding. Fertilizing with enough nitrogen for highest oat yield increases the risk of lodging and smothering of the forage seeding. Farmer experience on each field in previous years is the best guide to amount of nitrogen to apply. There is usually a profitable response in the oats to extra nitrogen up to the point where lodging occurs. Present varieties are much stiffer and will tolerate more nitrogen than those available before 1945.

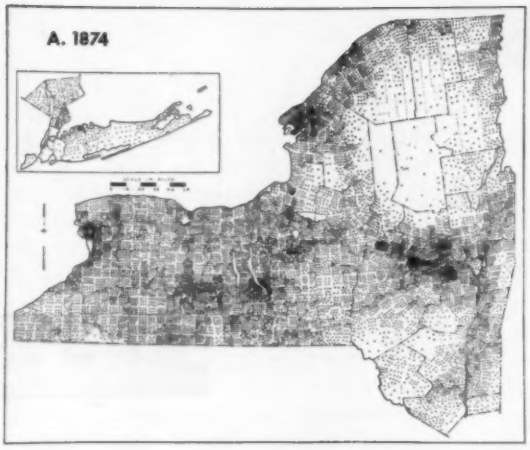
WEED CONTROL. Chemical sprays have been developed to control many weeds in oats, but the problem is how to control the weeds without killing the legume seeding. Progress is being made in selective weed killers and the current year's recommendations should be consulted (figure 25).

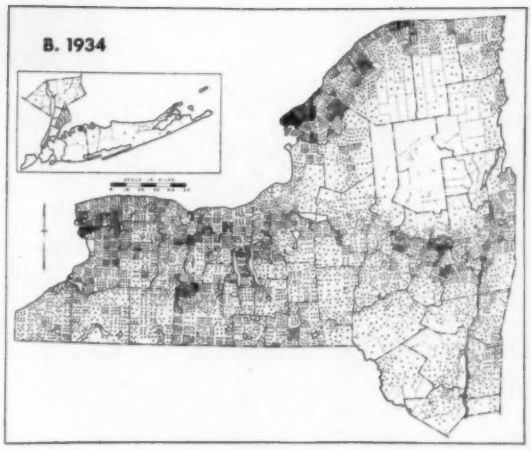
HARVEST. In the early years oats were cut with a cradle. Through most of the history of New York agriculture, oats were cut with a binder, shocked to dry, and then threshed. Combine harvesting (figure 23) came rapidly after 1940 with census data showing 5,853 combines in 1945, 10,830 in 1950, and 16,998 in 1954.

STORING AND USING. Most oats for grain are stored on the farm where produced, then ground and mixed with other home-grown or purchased grain and fed to dairy cattle or other livestock. In the Ontario Plain region some are sold to local elevators where they are ground, mixed with other grains and supplements, and resold locally as mixed feed.

About 5 to 7 percent of the oat acreage is cut for hay or silage and a smaller amount is pastured.

Figure 25. Chemical weed control has reduced the weed problem in oats. Tractor-mounted sprayers are widely used





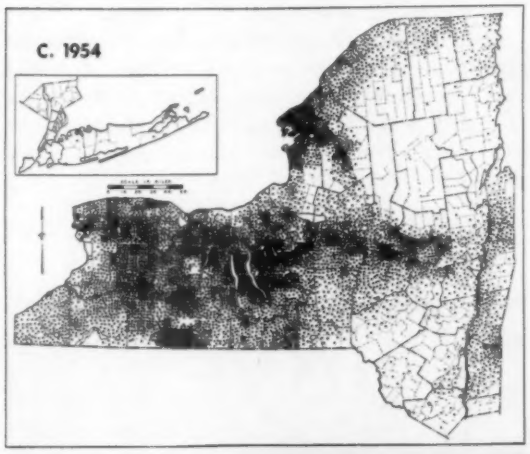


Figure 26. A,B,C. Oat acreage. 1 dot = 100 acres
D. Oat seed
E. Oat panicles
F. Stiff-strawed, disease-resistant oat variety

Seeds per pound	14,000
Pounds per bushel	32

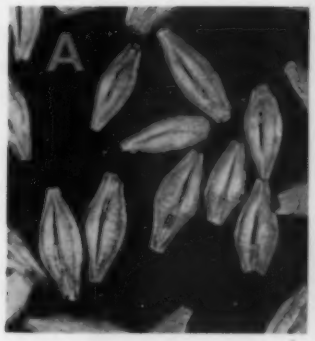
BARLEY

Spring barley was once an important crop in the state but has declined from 350,000 acres in 1880–1889 to less than 30,000 (table 2). Acreage in recent years cannot be directly compared with earlier years because winter barley is not listed separately. The use of barley in mixed spring grains has decreased sharply. The reasons for the great decline in spring barley acreage are not well understood. It is more exacting in soil fertility needs than oats and is more sensitive to acid soil. Contrary to farmer opinion, research shows that barley is more sensitive to late planting than oats. At Ithaca oats planted in late May yielded 40 percent less than those planted about mid-April; barley 67 percent less.

Cultural practices in growing spring barley are about the same as for oats. At one time barley was sold to the brewing industry to make malt, but this market has been gone from New York for many years except for a brief period during World War II. Most barley is fed to livestock.

Beginning before 1940 a small, but increasing, acreage of winter barley has been grown. Acreage restrictions on wheat stimulated winter barley production. Winter barley has thus far been limited to the more favorable wheat sites because winter barley is less winter hardy. The Hudson variety outyields other available varieties by 30 percent and may result in further increase in farmer interest. Winter barley under favorable conditions outyields spring barley by a wide margin, and Hudson compares with winter wheat in yield.

Cultural practices for winter barley are about the same as for wheat except that winter barley should be planted about one week earlier. It should be restricted to favorable wheat sites. It ripens a week to ten days before wheat. Winter barley is used mainly for feed.



Seeds per pound 13,000

Pounds per bushel 48

Figure 27—A. Barley seed
B. Barley spikes or "heads"
C. Good stand of barley. Note large number of tillers from each plant

BUCKWHEAT

New York once grew 254,000 acres of buckwheat (table 2 and figure 10) and for many years has been first or second in the United States in the crop. Buckwheat is planted later than any other grain —June 15 to July 5. It has been an emergency crop for late planting. Several factors contributed to its decline to about 30,000 acres. First, the flour market, which provided the highest price for the crop, decreased. Second, the abandonment of many farms with wet soils took buckwheat land out of agriculture. Third, oats, a competing crop, has increased in acre yields and the increased use of tractors permitted farmers to get oats planted before buckwheat planting time in most years. Finally, research on buckwheat varieties and cultural practices did not keep pace with that on other crops.

It appeared for a brief time that a sizable new market might develop for buckwheat in the form of a drug, rutin, which is made from the plant in early bloom, but this market has not materialized.

Buckwheat is planted with a grain drill at 3 to 5 pecks per acre. The main types are Silver Hull, Japanese, and Tartary. Tartary is unsuited for milling.

Buckwheat is used mainly for flour, livestock feed, and as a summer green manure crop.

RYE

Rye has declined from 254,000 acres in 1870–79 to 15,000 in 1956 (table 2 and figure 10). As a winter grain, rye competes with wheat and winter barley. It has averaged much lower in yield and acre value than these two grains. Rye is grown now largely to supply seed for fall cover crop plantings on intensively cropped fields. Cover crops are regularly used on vegetable crop farms to prevent erosion, reduce leaching of nutrients over winter, and to add organic matter. Rye is also planted in late summer to furnish late fall and early spring pasture. Rye is more winter hardy than wheat or barley and can therefore be planted later and on soils with marginal drainage and fertility for other winter grains. Cultural practices are about the same as for winter wheat.

Some rye is ground into flour for bread and a small amount is fed to livestock.

SOYBEANS

Soybeans have never been an important crop in New York. The total acreage increased from 3,241 in the 1930 census to 18,186 in the 1940 report, then declined to 10,862 in 1954. The increase in soybean acreage in the late 1930's and early 1940's was due to the need for a high protein supplement in mixed feeds. After World War II the supply and price of soybean oil meal from the midwest was favorable and acreage in New York declined. A processing plant at Oswego burned, but later was rebuilt to supply a market for beans. Soybeans cannot effectively compete with corn as a cash crop because soybean yields are more variable (table 3) and wet weather in the fall at harvest time often causes large losses.

Soybeans tolerate a wide range of soil drainage. They seldom respond well to direct applications of fertilizer and they are very sensitive to fertilizer injury. They are planted about a week after corn at a rate of 3 to 4 pecks in wide rows or 1½ to 2 bushels when drilled in 7-inch rows.

Soybeans are sometimes mixed with corn for silage. This practice has declined with the advent of 2,4–D spray for corn because soybeans are as easily killed as the weeds. Soybeans are also grown in mixture with sudangrass for silage, but there is little research to justify the mixture over sudangrass alone.

Soybeans are used for silage and for grain. The grain is sometimes mixed with other home-grown grains and ground. When soybeans are processed, the oil is extracted for cooking oil and industrial uses.

HAY (General)

Hay is the most important crop in the state, occupying about 58 percent of all harvested cropland and valued at $122,072,217 in the 1954 census. This is more than twice as much as any other field crop or as all vegetables or all fruits. Total acres declined from a peak of nearly 5 million before 1900 to about 3 million in 1956 (table 2) but the total tons harvested has declined very little (table 4). Yields have increased markedly (table 3 and figure 11) but the efficiency in production has not kept pace with other field crops (figure 13). Major trends are toward more perennial legumes, mainly alfalfa and birdsfoot trefoil, and early harvesting through more grass silage and barn drying.

SOILS. The important forage legumes and grasses have different tolerances (figure 28) and requirements for soil drainage. The drainage classes (figure 29) used in discussions of forage adaption are:

Good: Plow layer dry enough to work most years by the time grasses begin to grow. Subsoil rarely too wet during the growing season. No mottling. Some soils have hardpan below 24 inches; others have no limit to root penetration.

Moderate: Spring work delayed only slightly. About 12 to 20 inches of well-drained soil. Faint mottling below 15 to 20 inches.

Somewhat poor: Stays wet until late spring. Subsoil strongly mottled below 6 to 12 inches, showing that subsoil is often wet. Sometimes has hardpan at 15 to 18 inches.

Poor: Too wet to work in regular crop rotation. Usually level. Dark gray plow layer with grayish subsoil with strong mottling.

The zones labeled "mottled" have yellow, orange, and gray, or "rusty" streaks, indicating that they are sometimes quite wet during the growing season.

The zone labeled "root barrier" is so wet much of the time that there are few roots of most crops in it. It is a hardpan in some soils.

The suitability of the major legumes and grasses to the soil drainage classes is shown in figure 28.

Legumes also differ in their tolerance of soil acidity and response to fertilizer, especially potassium. As a rule these factors should be corrected in order to permit growing the best legume that is suited to the soil drainage situation.

CLIMATE. Like oats, the hay crops are less limited by elevation and latitude than are wheat and corn. On soils with similar drainage, pH, and fertility, the first and second cutting yields of hay are about the same in all parts of the state. The advantage in the areas with longer growing seasons is that legumes like alfalfa may be cut a third time and all meadows may be grazed later in the fall than in the shorter season areas. In the areas with the most severe winters, slightly hardier varieties of alfalfa are recommended and more careful management is encouraged. The areas that have the most summer rainfall (figure 4) also have the most difficulty in harvesting hay on time.

Tolerance of crops to soil moisture
The height and length of the bars show the tolerance of each crop

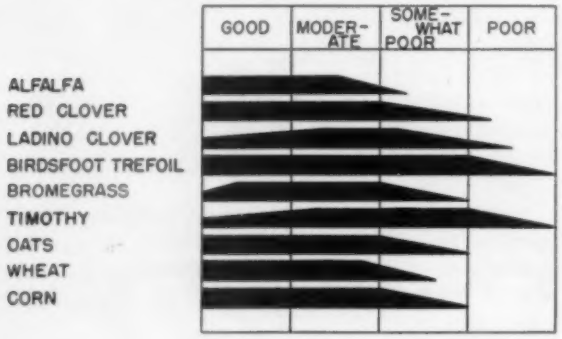


Figure 28

Soil drainage classes

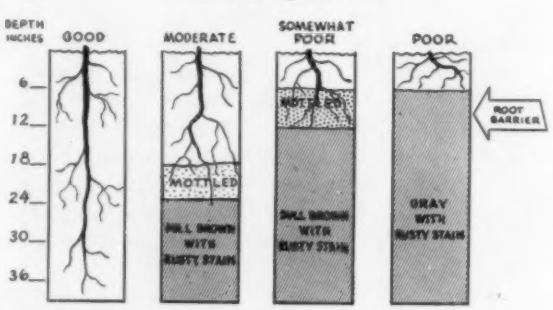


Figure 29

PLANTING. At least 95 percent of the hay and pasture seedings are made with a companion crop of small grain, or in a few cases, Sudan grass. An important problem is to get uniform coverage of ¼ to ½ inch. The seedbed must be fine and for spring seedings the seed tubes should be behind the grain tubes. More precise placement can be obtained with band seeding attachments on the drill. For summer seedings coverage is essential and some form of cultipacker seeding is desirable. Spring seedings are often made on fall-sown wheat and winter barley. If possible, the forage seeding should be made before the grain makes much spring growth.

LIMING. Acid soil more often limits the growth of legumes than any other factor. Soil pH tests can be made with a simple kit, and there is no reason for a farmer to seed without knowing whether the soil is adequately limed. The liming program is planned specifically for the legume, but benefits both directly and indirectly all other crops in the rotation. Lime may be considered a capital investment and enough applied at one time to neutralize the acidity of the plow layer with only maintenance applications thereafter. Or enough limestone may be applied in each rotation to grow the legume successfully. In 10 to 15 years the same total amount will be applied either way.

FERTILIZING. When forages are seeded with companion crops, the fertilizer application is aimed at meeting the needs of both. Pure stands of legumes require mainly phosphorus and potassium. Grasses respond mostly to nitrogen, but for high yields adequate levels of lime, phosphorus and potassium must be maintained. Usually a complete fertilizer is applied at planting time because of the needs of the companion crop. Perennial legumes are topdressed annually or every other year with manure or a fertilizer containing phosphorus or potassium or both. This depends upon soil type and the results of soil tests. Topdressing with potassium is most efficient after the first cutting of hay. The most profitable fertility program for grass meadows is alternate year treatment, with nitrogen in one year and a complete fertilizer or manure in the next.

HARVESTING. Recent research proves that early cutting is the first essential to high quality hay. Early cutting favors digestibility and palatability, which are both necessary in order to obtain a high proportion of feed nutrients from homegrown roughage. Early cutting increases aftermath and produces it at an opportune time, about the time that permanent pastures dry up. It also helps to control some leaf diseases. The time to cut legumes and grasses is described on the following pages.

The average date of the first cutting has been advanced 10 to 14 days since the 1920's. This has been due to more machinery plus better understanding of the advantages of early cutting.

The amount of hay stored as grass silage (figure 30) increased from 2 percent during 1941–1946 to about 8 percent by 1956. The number of mow driers increased from near zero in 1945 to an estimated 2,000 in 1957. A reasonable goal would be to store 30 to 50 percent of the first cutting as silage or barn dried hay. The amount of field-baled hay (figure 30) increased from near zero in 1940 to perhaps

Figure 30. The hay crop can be stored as silage, barn dried, or field cured and baled

50 percent of the crop by 1957. A detailed study on harvesting methods is reported in Experiment Station Bulletin 910.

STORING. At least 85 percent of the hay crop is stored in the hay mow as field-cured hay. Grass silage and barn drying improve hay quality by allowing early cutting, by reducing weather damage, and by saving leaves. No storage method completely eliminates losses, but preserving an early cut forage crop as wilted silage or barn-dried hay saves 10 to 15 percent more of the crop than unwilted silage or field cured hay.

FALL MANAGEMENT. All legumes in the fall of the seeding year and perennial legumes every year need careful management in order to survive the winter and produce well in the following year. Legumes need to store root reserves if they are to be winter hardy. They do this mainly in September in New York. The first 2 to 3 weeks of growth after cutting is made largely at the expense of root reserves. Therefore, cutting should be avoided during the period 4 to 6 weeks before the average date of the first killing frost in the fall (see map, figure 31). Fall management is not critical for established grasses, but continued close grazing reduces early spring growth.

MIXTURES. Specific information on mixtures is best obtained by studying the current year's recommendations from Cornell. Complex mixtures were common prior to 1945. Further research on varieties, soils, and management led to simple mixtures (one or two legumes plus a grass) "tailor-made" for specific soil situations and use rather than a "shot gun" mixture for a wide range of soils situations.

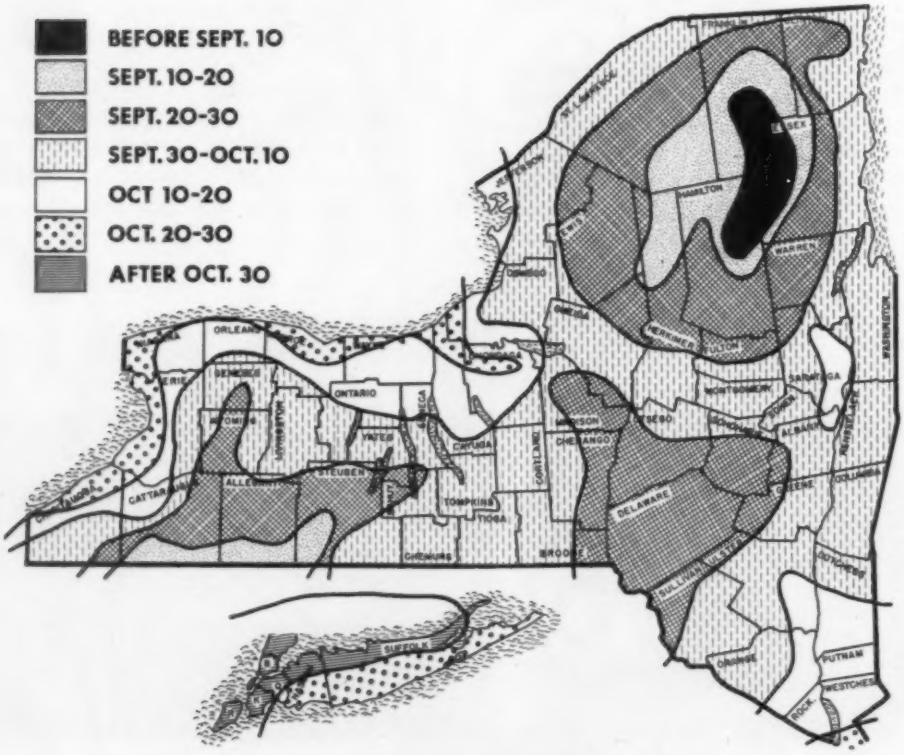


Figure 31. Average date of first killing frost by areas

ALFALFA

Alfalfa mixtures in New York, according to census data, increased from 2.4 percent of hayland harvested in 1920 to 26 percent in 1954. The value of alfalfa mixtures in 1954 was $44,206,316 and was exceeded among all crops only by clover-grass mixtures and field corn.

On soils where it is adapted, alfalfa is the highest yielding, most drouth resistant forage. Alfalfa is more exacting than other hay and pasture plants in soil drainage, pH, and phosphorus and potassium supply. Acreage is concentrated on the well-drained, high-lime, high potassium-supplying soils of the Ontario Plain region. Annual topdressing with potassium fertilizer is needed on some soils.

Recent research indicates that alfalfa acreage can be expanded to fields previously considered slightly too wet by (1) leaving red clover out of the mixture, (2) planting varieties with more seedling vigor, such as Narragansett, and (3) liming and fertilizing more liberally.

Alfalfa may be used for hay, silage, or rotation pasture. Some new extra-vigorous strains when well limed and fertilized may be cut three times and in longest season areas perhaps four times. Best time for the first cutting is when plants are 1/10 to 1/4 in bloom; second cutting near full bloom.

Alfalfa (except varieties like DuPuits) should not be cut or pastured later than 4 to 6 weeks before the average date of the first killing frost (figure 31) in order that it may build root reserves.

Major diseases are bacterial wilt and leaf spot.

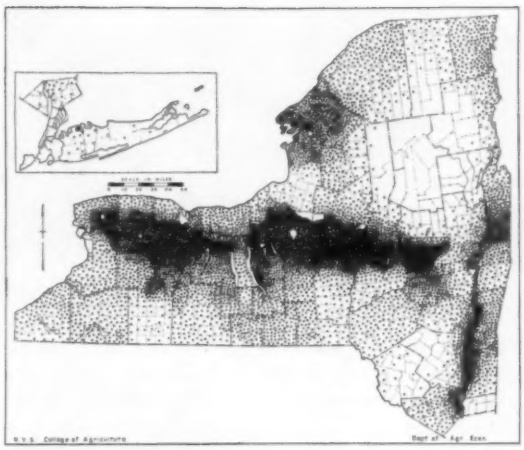
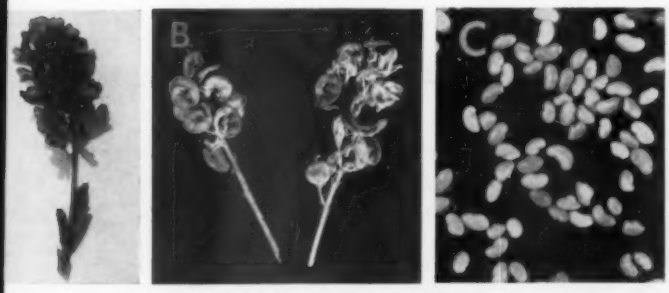


Figure 32. Alfalfa acreage, 1954. 1 dot = 100 acres

Resistant varieties are a partial solution to both. Early cutting reduces leafspot damage.

Major insects are spittle bug which attacks the first cut, leafhopper mainly on the second cut, alfalfa snout beetle in a small area on the east end of Lake Ontario, and a new insect, the alfalfa weevil, which moved in from the southeast. All may be controlled by timely application of the proper chemicals.

Small amounts of alfalfa seed are grown in the state, but to an increasing extent, seed is produced in irrigated areas of western states.



Seeds per pound 220,000

Pounds per bushel 60

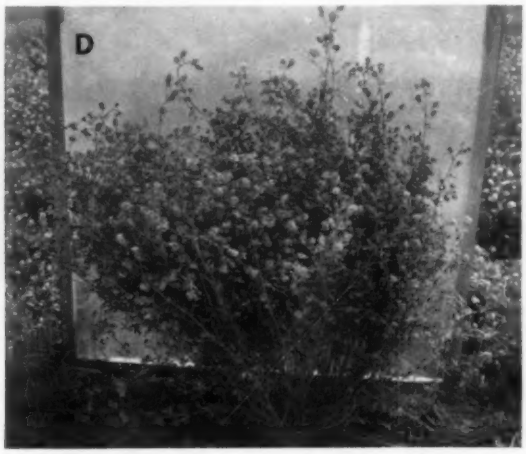


Figure 33—A. Alfalfa blossom, B. Alfalfa legume or "seed pod", C. Alfalfa seed, D. Alfalfa plant

BIRDSFOOT TREFOIL

Birdsfoot trefoil appears destined to become the second most important legume in the state. The first commercial quantity of seed harvested in New York was in 1937. By 1956 about 560,000 pounds were being seeded each year.

The two characteristics that recommend birdsfoot trefoil most for New York agriculture are long life and adaptation to a wide range of soils. Its main place is as a perennial legume on soils not suited to alfalfa. In practice this means that it is a replacement for red clover, alsike, and ladino clover where a stand of 3 years or more is desired. These legumes look better than birdsfoot in the first year but do not persist in hay meadows. Birdsfoot trefoil also has a place on well-drained steep hillsides where a very long-term stand is preferred.

Birdsfoot trefoil responds well to lime, but the most profitable level at which to maintain pH is about the same as for clovers and thus about 0.4 unit below alfalfa. The phosphorus requirement is about the same as for alfalfa, but the response to potassium appears to be somewhat less. For seedings made on low fertility soils, some nitrogen in the fertilizer is recommended to help establish the plants until they become well nodulated and can obtain adequate nitrogen from the air.

There are two distinct types of birdsfoot trefoil. Empire, the named variety from early stands in eastern New York, is slower to establish, later blooming, slower to recover after cutting, and less erect in second growth or under grazing than the early type. It is long-lived perhaps mainly because of reseeding. Empire is first choice for permanent pasture seedings, for poorly-drained, hard-to-plow fields, and for fields where the first cutting will be made late.

The early type trefoil is mainly imported from Europe but is now available in an improved strain from Cornell named Viking. It establishes more quickly, recovers more rapidly after cutting, blossoms earlier, is more erect in growth, and competes better with other legumes in mixtures than does Empire. The early type is preferred for most hay meadows. In 1956 seed sales of the early type were about 4 times those of Empire.

The best time to cut for hay is when the crop is near full bloom. Proper management is needed for best yield and quality but the plant is less exacting than alfalfa in management for survival. Birdsfoot trefoil, especially Empire, holds its leaves and green color for later harvesting than alfalfa and clovers. Once established, birdsfoot is much less likely to heave and winterkill on somewhat-poorly drained sites.

The most significant recent development in the use of birdsfoot trefoil of the early type is to combine it in mixtures with alfalfa for fields that are not uniformly well enough drained for alfalfa. The birdsfoot competes less strongly with alfalfa in the early stages of establishment than does red clover. Besides, the birdsfoot lives longer than red clover.

Diseases on birdsfoot are rather new but will likely increase as the crop is more widely grown. Spittle bug and leafhopper attack birdsfoot as well as alfalfa.

Seed production is a specialty crop on some farms in New York, with centers of production in Albany, Essex, and Cattaraugus Counties.

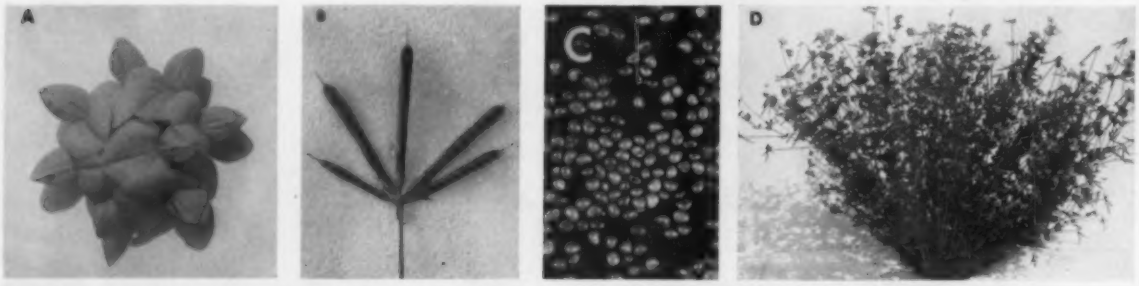


Figure 34—A. Birdsfoot trefoil blossom. B. Birdsfoot trefoil legume or "seed pod". C. Birdsfoot trefoil seed. D. Birdsfoot trefoil plant

Seeds per pound 375,000

Pounds per bushel 60

RED CLOVER

Before 1955 more red clover seed was used each year than any other legume. Since about 1955 it has been second to alfalfa. Red clover has been, in the history of New York agriculture, the heart of seeding mixtures on non-alfalfa land. Most alfalfa mixtures included red clover to increase the yield in the first harvest year and to fill in the wetter spots.

Red clover is adapted to a wide range of soil drainage conditions, is less sensitive than alfalfa to slightly acid soils, and is easily established. Unfortunately, it is essentially a one-year crop (figure 35). Because of its short life, it is not topdressed with potassium as are perennial legumes. Red clover ranks about with birdsfoot trefoil and somewhat below alfalfa in drouth tolerance.

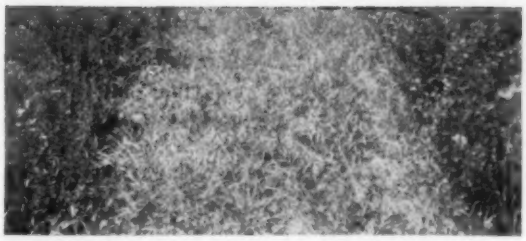


Figure 35. Red clover is adapted to a wide range of soil drainage conditions but is essentially a one-year crop

There are two types of red clover, medium and mammoth. Medium is preferred for hay because it produces about equal yield of higher quality hay. Mammoth is a one-cut crop. The one cutting is large but is somewhat coarse and stemmy. The medium type produces a second cutting for hay or pasture. Mammoth is very good as a green manure soil improving crop. From bud stage to half-bloom is the best time to cut for hay. Earlier cutting improves quality but some sacrifice in yield will result.

Red clover is still widely used in mixtures with alfalfa, although recent research indicates that it crowds out alfalfa on marginal drainage sites. Alfalfa is often crowded out by red clover in the seeding and first harvest year on soil situations where it would become established and produce a satisfactory stand with a less vigorous competing legume such as birdsfoot trefoil.

Red clover is the first or second choice of a legume for fields to be cut only one year and then plowed. On the most favorable soil situations, the newest alfalfa varieties may equal or excel red clover even for one year.

One insect severely attacks red clover and in fact makes it a biennial rather than a short-lived perennial under New York conditions. The clover root borer invades red clover roots during the first harvest year and by fall opens the roots to decay organisms. Nearly all plants die before the second harvest year, although a slightly higher proportion of plants of the newest varieties survive into the second crop year. Control measures have not developed to the point where they change the general picture of red clover as a one-year legume. Spittle bugs attack red clover but leafhoppers are less severe than on other legumes.

Anthracnose and leaf spots attack red clover. Resistant varieties are the answer to Anthracnose. Early cutting partly avoids, but does not control, leaf diseases.

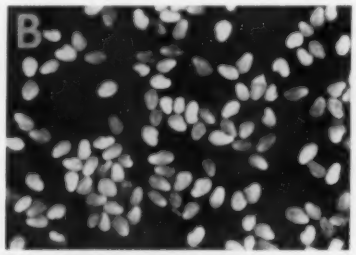


Figure 36—A. Red clover blossom
B. Red clover seed
C. Red clover plant

Seeds per pound 270,000

Pounds per bushel 60

LADINO CLOVER

Ladino clover is an important legume for grass silage and rotation pasture on fertile soils that are well supplied with moisture and are easily plowed and reseeded. It is easy to establish, starts growth early in the spring, recovers very rapidly after cutting or grazing, and is high in quality since only the leaves and leaf stalks are harvested. The stems are the creeping runners on the ground. Ladino and wild white clover are the only important forage legumes grown in the state that have a creeping habit of growth.

Ladino clover was introduced to New York farmers about 1940 and within 10 years was included in about one-third of all hay and pasture mixtures seeded. It was expected by many to become the perennial legume for nearly all land not suited to alfalfa. Under farm conditions ladino clover often makes an important contribution only to the aftermath in the first harvest year. Under an early cutting system for silage and in rotation pastures, the life is extended somewhat. Under pasture conditions it will cross with wild white clover and gradually the intermediate types from the cross replace the ladino. A farmer may not realize that he has lost the original vigorous ladino stand.

Ladino is difficult to cut and cure for hay. It is widely used for silage and rotation pasture mixtures but the acreage has not increased since 1952 or 1953. It is included with other legumes and grasses at a rate of ½ to 1 pound to the acre. Ladino is generally considered to be the best legume for poultry pastures.

The pH and phosphorus requirements are comparable to red clover and birdsfoot trefoil, but the potassium topdressing program should be the same as for alfalfa.

ALSIKE

For many years alsike was second to red clover in seed usage and was, in fact, a part of the most common mixture in New York—red clover, alsike, and timothy. Alsike is especially suited to poor drainage sites. It is the least sensitive legume to acid soils, but the same liming program is recommended as for red clover and birdsfoot trefoil. Alsike produces only one cutting in the first year and none the next. It has many hard seeds and re-establishes frequently on wet soils. It has weak stems and is not drouth resistant, but the hay is of high quality. The seeds are very small and it is usually seeded at 2 pounds per acre in mixture with other legumes.

Since ladino clover not only grows well under the same soil conditions as alsike but in addition makes a second growth and sometimes persists two or more years, it has rapidly replaced alsike.

WILD WHITE CLOVER

This is the smallest of the forage legumes and thus is easily killed by shading of taller species. Wild white clover is used only in long-term pasture mixtures. It is better suited than other legumes to close, continuous grazing. It is sensitive to drouth and, therefore, makes most of its growth in May and early June except in years or on soils with plenty of moisture.

Most native pastures in New York contain enough seeds to produce a full stand without seeding within two or three years after the pasture is limed and fertilized. Wild white clover has a creeping growth habit. It is seeded at 1 to 2 pounds in mixtures.

SWEET CLOVER

Sweet clover is little used in New York and the acreage is declining. Where it grows well, biennial sweet clover is unequalled as a soil-improving crop. It is rarely used for forage. It starts very early in the spring and is coarse and stemmy by hay harvest time. It can be used for grass silage. As a pasture crop, it produces a heavy growth early, but before mid-summer it is coarse and unpalatable.

Sweet clover has a higher pH requirement than alfalfa but will grow on somewhat wetter soils. Sweet clover sometimes has a high coumarin content, especially if fed as hay that has been severely weather damaged. The blood of animals consuming hay with high coumarin content will not clot and if injured the animals may bleed to death.

GRASSES

At least one-half of the hay and pasture forage eaten by New York livestock is grass. Grass is an important part of nearly all meadows after the first harvest year and is the major part of those mixtures that do not contain alfalfa or birdsfoot trefoil.

Grasses are less sensitive to soil acidity and poor drainage than are legumes. They are also less sensitive to fall cutting or grazing. The first fertilizer need is usually nitrogen. After the legume has thinned to less than 20 to 30 percent of the mixture, it is usually profitable to start alternate year treatment with nitrogen one year and complete fertilizer or manure the next.

There are three major grasses—timothy, smooth bromegrass, orchardgrass—and several minor ones for seeding—Reed canary grass, redtop, and Kentucky bluegrass.

TIMOTHY. This is by far the most important forage grass seeded in New York. It is adapted to a wide range of soil drainage, is easily established, produces a good yield, and when cut at the proper stage (headed to early bloom) is highly palatable. Its main weaknesses are small amount of second growth, moderate sensitivity to drouth, and heavy leaf loss when cutting is delayed. New late-maturing strains have been developed to retain leaves and color better. Timothy does not start especially early in the spring nor recover rapidly after cutting. It does not spread by rootstocks.

SMOOTH BROMEGRASS. New York farmers began to plant bromegrass just before 1940. It rapidly became popular in alfalfa mixtures in the Ontario Plain region. Since 1950 the acreage has grown steadily but not rapidly.

Bromegrass begins spring growth about the same time as timothy but retains its leaves and palatability somewhat later. It is slightly more drouth resistant than timothy, and new strains have been developed that produce more aftermath. Bromegrass has creeping rootstocks, and so the stand thickens and fills in open areas. It is better suited for pasture than timothy.

Bromegrass is more difficult to seed than other grasses. The seed is large and chaffy. The most common method for seeding is to mix it with spring grains or early planted wheat and plant the combination about 1 inch deep. Too deep planting is the cause of much disappointment with bromegrass seedings. The mixture must be agitated to reduce separation of the grain and lighter weight grass seed.

Bromegrass seems to be especially sensitive to nitrogen supply. It is best seeded with a perennial legume such as alfalfa or birdsfoot trefoil and liberally topdressed with nitrogen fertilizer or manure after the legume thins out.

ORCHARDGRASS. This grass is easily established, starts growth very early in the spring, recovers rap-

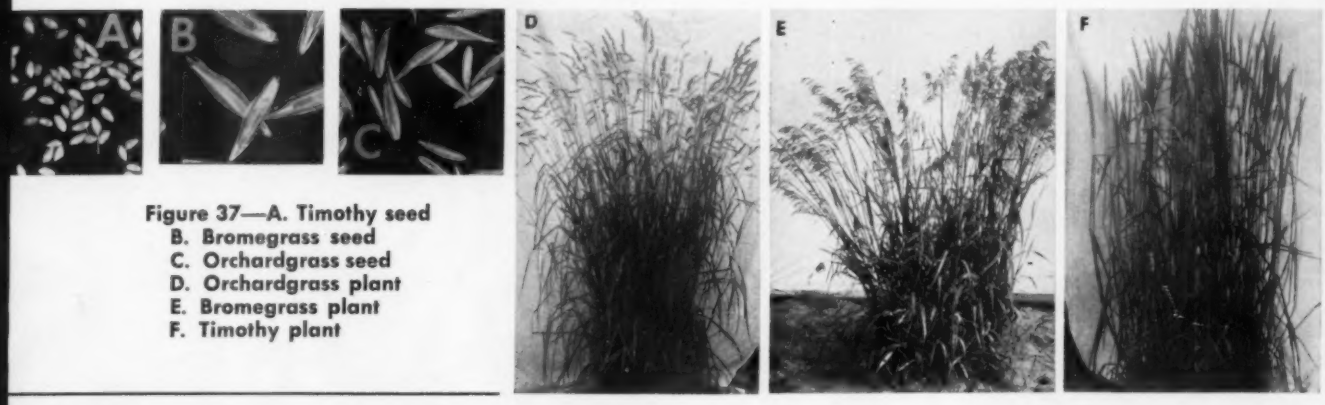


Figure 37—A. Timothy seed
B. Bromegrass seed
C. Orchardgrass seed
D. Orchardgrass plant
E. Bromegrass plant
F. Timothy plant

Timothy seeds per pound 1,200,000
Pounds per bushel 45

Orchardgrass seeds per pound 560,000
Pounds per bushel 14

Bromegrass seeds per pound 150,000
Pounds per bushel 14

idly after cutting or grazing, is more drouth resistant than timothy and bromegrass, and grows well at high summer temperatures. The principal problem is management during May and June while it is growing vigorously. It should be cut in the early heading stage. It is not suited for hay because it passes the best stage to cut before the date of good haying weather. Orchardgrass is the best grass for a grass silage program because of its early growth and rapid recovery. It produces well in a rotation pasture system, but some farmers complain that livestock selectively graze the legume and leave the orchardgrass. It is not suited to poorly-drained soils because timothy and bromegrass outyield it, and besides the problem of timely harvest is greater than on soils with better drainage.

Orchardgrass is the only grass definitely favored by spring seeding. Later maturing and more leafy strains are being developed.

REED CANARYGRASS. This is the most drouth resistant grass as well as the one best suited to the wettest soils. It starts very early in the spring, grows vigorously, and by haying time is quite coarse. It is best suited for silage and to a lesser extent for summer pasture, but not for hay. Palatability is only fair. Canarygrass is grown mainly on sites too wet for other grasses and too wet for regular harvest, but because of its drouth resistance, it produces well even on well-drained soils. Reed Canarygrass spreads vigorously by rootstocks.

REDTOP. Like Reed Canarygrass, redtop is suited to the full range of soil drainage conditions. It is reported to be adapted to acid, infertile soils, but no forage grass or legume is very productive under such conditions. For most farm situations, one of the three major grasses is more productive. Redtop forms a tough sod and is excellent for seeding sod waterways. Its use in hay and pasture seedings is rapidly declining.

Figure 38. Well fertilized properly managed bluegrass pastures provide cheap high quality forage in the spring and early summer

KENTUCKY BLUEGRASS. This is the most important grass in improved native pastures but is not suited for hay. Since 1945 Kentucky bluegrass has been replaced in seeded mixtures by taller growing species. Bluegrass, however, invades and replaces most seeded grasses after a few years of close grazing.

Kentucky bluegrass is best adapted to a cool, moist season. For this reason it produces well during May and early June, but is often nearly dormant during mid-summer. It renews growth after fall rains and may supply several weeks of good grazing (figure 38).

Cooperative Extension Service, New York State College of Agriculture at Cornell University and the U. S. Department of Agriculture cooperating. In furtherance of Acts of Congress May 8, June 30, 1914. M. C. Bond, Director of Extension, Ithaca, New York.